Fiscal Federalism and Monetary Unions

Rafael Berriel[1] Eugenia Gonzalez-Aguado[2] Patrick Kehoe[3] Elena Pastorino[4]

[1]Stanford [2]TSE [3]Stanford [4]Stanford and Hoover

AEA Annual Meeting 2025

The Question of Fiscal Delegation

- How should policy choices be delegated between central and local fiscal authorities?

  "*We should know over which matters local tribunals are to have jurisdiction, and in which authority should be centralized*."

The Question of Fiscal Delegation

- How should policy choices be delegated between central and local fiscal authorities?

  "*We should know over which matters local tribunals are to have jurisdiction, and in which authority should be centralized*." Aristotle, Politics 4.15 (350 BCE)

The Question of Fiscal Delegation

- How should policy choices be delegated between central and local fiscal authorities?

  "*We should know over which matters local tribunals are to have jurisdiction, and in which authority should be centralized*." Aristotle, Politics 4.15 (350 BCE)

- This question has been around for millenia but still no settled answer: e.g., in the case of EU
  - Tabellini (2002) argues that one of the most pressing questions for the union is
  - "*What tasks should the EU have and which ones should be left to the Member States*"

The Question of Fiscal Delegation

- How should policy choices be delegated between central and local fiscal authorities?

  "*We should know over which matters local tribunals are to have jurisdiction, and in which authority should be centralized*." Aristotle, Politics 4.15 (350 BCE)

- This question has been around for millenia but still no settled answer: e.g., in the case of EU
  - Tabellini (2002) argues that one of the most pressing questions for the union is
  - "*What tasks should the EU have and which ones should be left to the Member States*"

- Fiscal delegation also relevant at the *country level*
  - complex rules of fiscal federalism in Argentina and Brazil responsible for their poor macro performance
  - e.g. Saiegh and Tommasi (1999), Nicolini et al. (2002) and Cooper and Kempf (2004)

Next: two views on fiscal delegation

Fiscal Federalism View on Monetary Unions

- Local authority is better unless fiscal externalities are large

Fiscal Federalism View on Monetary Unions

- Local authority is better unless fiscal externalities are large
- Why? As in the work of Oates (1972)
  - micro literature presumes that absent externalities, local authorities are preferable
- Idea: local authorities are better at tailoring policies to the tastes of local citizens
  - Oates (1972) approach: verbally presumes locals have better information but just imposes *uniform* policies
  - recent political economy literature: micro-founded approach that similarly argues local authority is superior
  - so local authorities preferred unless there are large externalities
- Main takeaway: in general *large benefits* to decentralization

Macro View on Monetary Unions

- Centralized fiscal authority is always better

Macro View on Monetary Unions

- Centralized fiscal authority is always better
- Why? As in the work of, say, Chari and Kehoe (2008) and Aguiar et al. (2015)
  - macro literature presumes that absent externalities, central and local authorities are equally good
  - so *even small* externalities make centralized authority better because it can internalize them

Macro View on Monetary Unions

- Centralized fiscal authority is always better
- Why? As in the work of, say, Chari and Kehoe (2008) and Aguiar et al. (2015)
  - macro literature presumes that absent externalities, central and local authorities are equally good
  - so *even small* externalities make centralized authority better because it can internalize them
- Idea: if a country has high levels of nominal debt, it induces the monetary authority to *inflate*
  - decentralized fiscal authority does not take into account the costs of inflation on others
  - centralized fiscal authority does, so it tries harder to reduce its debt leading to less inflation
  - so central authority is always better because it internalizes these externalities
- Main takeaway: *no benefit* to decentralization

Our View: Both Fiscal Federalism and Macro Forces Relevant

- We incorporate both forces
  - information benefit of decentralization in the spirit of fiscal federalism literature
    - central fiscal authority *cannot tailor fiscal policies* as well to local preferences
  - externality benefit of centralization in the spirit of macro literature
    - central fiscal authority internalizes the *inflationary cost of debt*

- We do so in a dynamic framework for fiscal and monetary policy in which under centralization
  - debt and inflation are outcomes of one central authority
  - but with noisy information about each country's fiscal needs

- Instead, under decentralization, both debt and inflation
  - are outcomes of strategic decisions of finite no. local authorities (hence "large players")
  - but with perfect information about their own fiscal needs

How Do We Contribute to Macro Literature?

- Existing work does not address the optimality of delegation
  - *only considers decentralized regimes* and examines when *debt limits* eliminate externalities
  - e.g. EU's Stability and Growth Pact specified large penalties (.5% of annual GDP) if violate them
  - but in practice limits not credible, many countries who *severely violated them* were never penalized

- We start from premise that non-credibility of such fiscal rules makes them *irrelevant* in practice
  - thus purposely restrict individual countries to have *no power* on debt or spending under centralization
  - this ensures no issues of ex-post credibility of punishments arise

- Indeed current debate within EUis is no longer about debt limits: rather focus now is
  - on how to allocate decision-making power over fiscal policies btw central and local authorities
  - this is the question we address

This Paper

- Build dynamic model that captures how *debt* and *inflation* dynamics vary across fiscal regimes
  - both central and local fiscal authorities wish to reduce their nominal debt to decrease inflation

- Trade-off: centralized authority reduces debt faster but at the cost of not tailoring policies as much

This Paper

- Build dynamic model that captures how *debt* and *inflation* dynamics vary across fiscal regimes
  - both central and local fiscal authorities wish to reduce their nominal debt to decrease inflation
- Trade-off: centralized authority reduces debt faster but at the cost of not tailoring policies as much
- Main goal: characterize
  - debt and inflation dynamics in macro model with strategic interactions
  - how optimal delegation of fiscal authority changes with number of countries in union

This Paper

- Build dynamic model that captures how *debt* and *inflation* dynamics vary across fiscal regimes
  - both central and local fiscal authorities wish to reduce their nominal debt to decrease inflation
- Trade-off: centralized authority reduces debt faster but at the cost of not tailoring policies as much
- Main goal: characterize
  - debt and inflation dynamics in macro model with strategic interactions
  - how optimal delegation of fiscal authority changes with number of countries in union
- Main theoretical and policy results
  - cutoff rule: centralization is preferred if and only if the number of countries is sufficiently large
  - implication for EU: enlargement makes centralization relatively more desirable

Model

Model

- Incorporate strategic interactions (finite countries, I) and information friction to Aguiar et al. (2015)

- Each country/region in the monetary union has a representative agent

Model

- Incorporate strategic interactions (finite countries, I) and information friction to Aguiar et al. (2015)
- Each country/region in the monetary union has a representative agent
- Countries are identical except for their preferences for public and private goods
  - we abstract from transfers across countries or any redistribution mechanism
- Compare two regimes: central vs. local fiscal authority (centralized vs. decentralized)

Model

- Incorporate strategic interactions (finite countries, I) and information friction to Aguiar et al. (2015)
- Each country/region in the monetary union has a representative agent
- Countries are identical except for their preferences for public and private goods
  - we abstract from transfers across countries or any redistribution mechanism
- Compare two regimes: central vs. local fiscal authority (centralized vs. decentralized)
- Main technical contribution
  - solving a dynamic macro model with strategic interactions
  - key difference from most of the literature: not a *big K–little k* problem

Technology, Preferences and Information Structure

- Production function in each country i with labor as only input: $y_{it} = \ell_{it}$

Technology, Preferences and Information Structure

- Production function in each country i with labor as only input: $y_{it} = \ell_{it}$
- Representative agent in i has preferences over private consumption c and (local) public goods g

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

  - linear disutility from working $\ell \leq \overline{\ell}$ and inflation, $\psi\pi$: nests Aguiar et al. (2015) if $\theta = 0$ and $I = \infty$
  - θ_{it} are iid shocks across countries

Technology, Preferences and Information Structure

- Production function in each country i with labor as only input: $y_{it} = \ell_{it}$
- Representative agent in i has preferences over private consumption c and (local) public goods g

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

  - linear disutility from working $\ell \leq \overline{\ell}$ and inflation, $\psi\pi$: nests Aguiar et al. (2015) if $\theta = 0$ and $I = \infty$
  - θ_{it} are iid shocks across countries
- Local fiscal authority: perfectly observes θ_{it}
- Central fiscal authority: observes noisy signal s_{it} about it
  - idea: local authority tries to communicate θ_{it} but this type of communication difficult
  - leading example: $\theta_{it} \in \{\theta_L, \theta_H\}$, $0 < \theta_L < \theta_H < 1$, and θ_{it} switches from θ_L to θ_H and vice versa at rate λ
  - central fiscal authority learns value of current θ_{it} with Poisson rate $\phi \rightarrow$ degree of informativeness

Interpretation of Information Structure

- Benefit of decentralization: central authority observes only noisy signal of local preferences
- But can't the central authority easily elicit each locality's tastes via simple mechanisms?
- True in principle since no incentive issues: ask individuals about their tastes
- But empirical evidence suggests even eliciting partners' tastes for a holiday present is hard
  - Waldfogel (1993) estimates that holiday gifts destroy 10% of their value when given from partner
  - destroy 1/3 of their value when given from a member of extended family (e.g. aunt)

Next: how do countries borrow?

Debt Dynamics and Foreign Lenders

- Countries borrow from foreigners by issuing non-defaultable nominal debt, b_{it} (in real terms)
- Risk-neutral foreign lenders buy this nominal debt b_{it} with opportunity cost of funds ρ
- Letting i_t denote the nominal interest rate, the law of motion of debt in country i is

$$\dot{b}_{it} = c_{it} + g_{it} - \ell_{it} + (i_t - \pi_t)\, b_{it}$$

- This is a fiscal authority's budget constraint

Roadmap

- No information benefit of decentralization ($\theta_{it} = 0$ for all i and t)
  - centralized regime: monetary authority and centralized fiscal authority
  - decentralized regime: monetary authority and decentralized fiscal authorities
  - compare welfare across regimes

- Add information benefit of decentralization
  - compare value in regimes
  - main result: cutoff rule

- Throughout, monetary authority lacks commitment to inflation policy
  - if instead it had commitment, would set inflation to zero leading to no fiscal externalities

Centralized Regime

Markov Perfect Equilibrium

- Denote $\boldsymbol{b} = (b_1, \ldots, b_I)$ the vector of current debt in each country
- An equilibrium is
  - interest rate schedule, $i(\boldsymbol{b})$
  - fiscal rules, $c_i(\boldsymbol{b})$ and $\ell_i(\boldsymbol{b})$, for all i
  - inflation rule, $\pi(\boldsymbol{b})$

  such that given interest rate schedule and

$a)$ an inflation rule, foreign lenders are willing to lend

$b)$ an inflation rule, fiscal rules maximize fiscal authority objective

$c)$ fiscal rules, inflation rule maximizes monetary authority objective

Foreign Lenders Problem

- Foreign lenders have
  - deep-pockets and are competitive
  - real opportunity cost ρ, which equals the discount rate of consumers
- Take as given $i(\boldsymbol{b})$ and $\pi(\boldsymbol{b})$ and choose how much B to lend

$$\max_{B} \left[i(\boldsymbol{b}) - \pi(\boldsymbol{b}) - \rho \right] B$$

- Competition implies perfectly elastic supply of funds at nominal rate $i(\boldsymbol{b})$, where

$$i(\boldsymbol{b}) = \rho + \pi(\boldsymbol{b})$$

Monetary Authority Problem

- Takes as given
  - vector of current debt in each country $\boldsymbol{b} = (b_1, \ldots, b_I)$
  - fiscal rules chosen by the central fiscal authority $(c_i(\boldsymbol{b}), l_i(\boldsymbol{b}))$ for all i
  - nominal interest rate $i(\boldsymbol{b})$

Monetary Authority Problem

- Takes as given
  - vector of current debt in each country $\boldsymbol{b} = (b_1, \ldots, b_I)$
  - fiscal rules chosen by the central fiscal authority $(c_i(\boldsymbol{b}), l_i(\boldsymbol{b}))$ for all i
  - nominal interest rate $i(\boldsymbol{b})$
- Chooses $\pi_t \in [0, \overline{\pi}]$ to utility of all countries in the union, namely to solve

$$J(\boldsymbol{b}_0) = \max_{\{\pi_t\}} \frac{1}{I} \sum_i \int_0^\infty e^{-\rho t}[u(c_i(\boldsymbol{b}_t)) - \ell_i(\boldsymbol{b}_t) - \psi\pi_t]dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_i(\boldsymbol{b}_t) + [i(\boldsymbol{b}_t) - \pi_t]b_{it} - \ell_i(\boldsymbol{b}_t)$$

  - what is the tension? Because monetary authority lacks commitment to inflation policy
  - temptation to inflate: decreases the real value of debt to be repaid to foreigners
  - cost from inflating: direct linear utility cost $\psi\pi_t$ (reduced-form output cost)

Monetary Authority Problem

- Takes as given
  - vector of current debt in each country $\boldsymbol{b} = (b_1, \ldots, b_I)$
  - fiscal rules chosen by the central fiscal authority $(c_i(\boldsymbol{b}), l_i(\boldsymbol{b}))$ for all i
  - nominal interest rate $i(\boldsymbol{b})$
- Chooses $\pi_t \in [0, \overline{\pi}]$ to utility of all countries in the union, namely to solve

$$J(\boldsymbol{b}_0) = \max_{\{\pi_t\}} \frac{1}{I} \sum_i \int_0^\infty e^{-\rho t}[u(c_i(\boldsymbol{b}_t)) - \ell_i(\boldsymbol{b}_t) - \psi\pi_t]dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_i(\boldsymbol{b}_t) + [i(\boldsymbol{b}_t) - \pi_t]b_{it} - \ell_i(\boldsymbol{b}_t)$$

  - what is the tension? Because monetary authority lacks commitment to inflation policy
  - temptation to inflate: decreases the real value of debt to be repaid to foreigners
  - cost from inflating: direct linear utility cost $\psi\pi_t$ (reduced-form output cost)
  - both the temptation and the cost are *linear* so either inflate 0 or $\overline{\pi}$

Monetary Authority Problem

- Takes as given
  - vector of current debt in each country $\boldsymbol{b} = (b_1, \ldots, b_I)$
  - fiscal rules chosen by the central fiscal authority $(c_i(\boldsymbol{b}), l_i(\boldsymbol{b}))$ for all i
  - nominal interest rate $i(\boldsymbol{b})$
- Chooses $\pi_t \in [0, \overline{\pi}]$ to utility of all countries in the union, namely to solve

$$J(\boldsymbol{b}_0) = \max_{\{\pi_t\}} \frac{1}{I} \sum_i \int_0^\infty e^{-\rho t}[u(c_i(\boldsymbol{b}_t)) - \ell_i(\boldsymbol{b}_t) - \psi\pi_t]dt$$

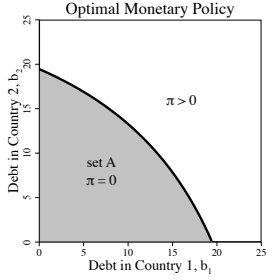
$$\text{s.t.} \quad \dot{b}_{it} = c_i(\boldsymbol{b}_t) + [i(\boldsymbol{b}_t) - \pi_t]b_{it} - \ell_i(\boldsymbol{b}_t)$$

  - what is the tension? Because monetary authority lacks commitment to inflation policy
  - temptation to inflate: decreases the real value of debt to be repaid to foreigners
  - cost from inflating: direct linear utility cost $\psi\pi_t$ (reduced-form output cost)
  - both the temptation and the cost are *linear* so either inflate 0 or $\overline{\pi}$ as illustrated next

Best Response of the Monetary Authority $I = 2$

- The best response has the form

$$\pi(b_1, b_2) = \begin{cases} 0 & \text{if} \quad (b_1, b_2) \in A \\ \bar{\pi} & \text{otherwise} \end{cases}$$



- If countries' debts are small $\pi = 0$; otherwise, $\pi = \overline{\pi}$

Next: problem of centralized fiscal authority

Central Fiscal Authority

- Taking as given $i(\boldsymbol{b})$ and $\pi(\boldsymbol{b})$, the problem of the centralized fiscal authority is

$$V^C(\boldsymbol{b}) = \max_{\dot{b}_{it}, c_{it}, \ell_{it} \in [0,\overline{\ell}]} \frac{1}{I} \sum\nolimits_i \int_0^\infty e^{-\rho t} \left[u(c_{it}) - \ell_{it} - \psi \pi(\boldsymbol{b}) \right] dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_{it} - \ell_{it} + [i(\boldsymbol{b}) - \pi(\boldsymbol{b})] b_{it} \qquad \text{for all } i \text{ and } t$$

- Equilibrium nominal rate pinned-down by foreigners ($i(\boldsymbol{b}) = \rho + \pi(\boldsymbol{b})$) so real rate $\rho = i(\boldsymbol{b}) - \pi(\boldsymbol{b})$

Central Fiscal Authority

- Taking as given $i(\boldsymbol{b})$ and $\pi(\boldsymbol{b})$, the problem of the centralized fiscal authority is

$$V^C(\boldsymbol{b}) = \max_{\dot{b}_{it}, c_{it}, \ell_{it} \in [0,\overline{\ell}]} \frac{1}{I} \sum_i \int_0^\infty e^{-\rho t} \left[u(c_{it}) - \ell_{it} - \psi \pi(\boldsymbol{b}) \right] dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_{it} - \ell_{it} + [i(\boldsymbol{b}) - \pi(\boldsymbol{b})] b_{it} \qquad \text{for all } i \text{ and } t$$

- Equilibrium nominal rate pinned-down by foreigners ($i(\boldsymbol{b}) = \rho + \pi(\boldsymbol{b})$) so real rate $\rho = i(\boldsymbol{b}) - \pi(\boldsymbol{b})$

- Consider $\boldsymbol{b}$ such that $\pi(\boldsymbol{b}) = 0$
  - since real rate equals the discount rate, optimal debt accumulation is $\dot{b}_{it} = 0$ (consumption smoothing)

Central Fiscal Authority

- Taking as given $i(\boldsymbol{b})$ and $\pi(\boldsymbol{b})$, the problem of the centralized fiscal authority is

$$V^C(\boldsymbol{b}) = \max_{\dot{b}_{it}, c_{it}, \ell_{it} \in [0,\overline{\ell}]} \frac{1}{I} \sum_i \int_0^\infty e^{-\rho t} \left[u(c_{it}) - \ell_{it} - \psi \pi(\boldsymbol{b}) \right] dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_{it} - \ell_{it} + [i(\boldsymbol{b}) - \pi(\boldsymbol{b})] b_{it} \qquad \text{for all } i \text{ and } t$$

- Equilibrium nominal rate pinned-down by foreigners ($i(\boldsymbol{b}) = \rho + \pi(\boldsymbol{b})$) so real rate $\rho = i(\boldsymbol{b}) - \pi(\boldsymbol{b})$

- Consider $\boldsymbol{b}$ such that $\pi(\boldsymbol{b}) = 0$
  - since real rate equals the discount rate, optimal debt accumulation is $\dot{b}_{it} = 0$ (consumption smoothing)

- The solution is $(\hat{c}_i(b_i), \hat{\ell}_i(b_i))_i$
  - the monetary authority takes as given this rule when choosing inflation

Central Fiscal Authority

- Taking as given $i(\boldsymbol{b})$ and $\pi(\boldsymbol{b})$, the problem of the centralized fiscal authority is

$$V^C(\boldsymbol{b}) = \max_{\dot{b}_{it}, c_{it}, \ell_{it} \in [0,\overline{\ell}]} \frac{1}{I} \sum\nolimits_i \int_0^\infty e^{-\rho t} \left[u(c_{it}) - \ell_{it} - \psi \pi(\boldsymbol{b}) \right] dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_{it} - \ell_{it} + [i(\boldsymbol{b}) - \pi(\boldsymbol{b})] b_{it} \qquad \text{for all } i \text{ and } t$$

- Equilibrium nominal rate pinned-down by foreigners ($i(\boldsymbol{b}) = \rho + \pi(\boldsymbol{b})$) so real rate $\rho = i(\boldsymbol{b}) - \pi(\boldsymbol{b})$

- Consider $\boldsymbol{b}$ such that $\pi(\boldsymbol{b}) = 0$
  - since real rate equals the discount rate, optimal debt accumulation is $\dot{b}_{it} = 0$ (consumption smoothing)

- The solution is $(\hat{c}_i(b_i), \hat{\ell}_i(b_i))_i$
  - the monetary authority takes as given this rule when choosing inflation: we characterize its policy next

Next: substitute fiscal authority's rule into MA's problem to characterize zero inflation set A

Monetary Authority: The Equilibrium Inflation Rule

Proposition. The equilibrium inflation rule is

$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \boldsymbol{b} \in A \\ \bar{\pi} & \text{otherwise} \end{cases}$$

where

$$A \equiv \left\{ \boldsymbol{b} : \psi \geq \frac{1}{I} \sum\nolimits_i u'(\hat{c}_i(b_i)) b_i \right\}$$

and $\hat{c}_i(b) = \min\{c^*, \bar{\ell} - \rho b\}$ is optimal consumption with c^* such that $u'(c^*) = 1$. proof

Monetary Authority: The Equilibrium Inflation Rule

Proposition. The equilibrium inflation rule is

$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \boldsymbol{b} \in A \\ \bar{\pi} & \text{otherwise} \end{cases}$$

where

$$A \equiv \left\{ \boldsymbol{b} : \psi \geq \frac{1}{I} \sum\nolimits_i u'(\hat{c}_i(b_i)) b_i \right\}$$

and $\hat{c}_i(b) = \min\{c^*, \bar{\ell} - \rho b\}$ is optimal consumption with c^* such that $u'(c^*) = 1$. proof

- Intuition: ignoring $u'(\cdot)$, temptation outweighs cost if average debt $\frac{1}{I} \sum_i b_i$ above marginal cost ψ
- With concave preferences, true temptation adjusts each b_i by marginal disutility of debt $u'(\hat{c}_i(b_i))$
- In this case, π is maximal (o/w, π is zero)

Monetary Authority: The Equilibrium Inflation Rule

Proposition. The equilibrium inflation rule is

$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \boldsymbol{b} \in A \\ \bar{\pi} & \text{otherwise} \end{cases}$$

where

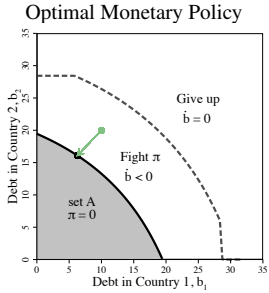
$$A \equiv \left\{ \boldsymbol{b} : \psi \geq \frac{1}{I} \sum\nolimits_i u'(\hat{c}_i(b_i)) b_i \right\}$$

and $\hat{c}_i(b) = \min\{c^*, \bar{\ell} - \rho b\}$ is optimal consumption with c^* such that $u'(c^*) = 1$. proof

- Intuition: ignoring $u'(\cdot)$, temptation outweighs cost if average debt $\frac{1}{I} \sum_i b_i$ above marginal cost ψ
- With concave preferences, true temptation adjusts each b_i by marginal disutility of debt $u'(\hat{c}_i(b_i))$
- In this case, π is maximal (o/w, π is zero): now substitute MA's π rule into central FA's problem

The Equilibrium Fiscal Rules: Intuition for $I = 2$

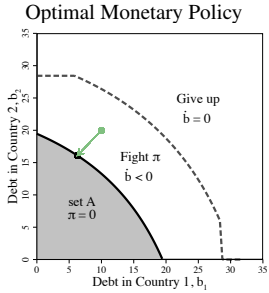
1. *No inflation*: if $(b_1, b_2) \in A$ then set $\dot{b} = 0$
2. *Fight inflation*: if $(b_1, b_2) \in A^C$ but "not too far" from A
   - countries fight inflation by decreasing their debt levels so set $\dot{b} < 0$ until they reach set A
3. *Give up fighting inflation*: if $(b_1, b_2) \in A^C$ and "too far" from A
   - countries give up fighting inflation: $\dot{b} = 0$



Note: results extend to case $I > 2$ in symmetric case we focus from now on for simplicity

The Equilibrium Fiscal Rules: Intuition for $I = 2$

1. *No inflation*: if $(b_1, b_2) \in A$ then set $\dot{b} = 0$
2. *Fight inflation*: if $(b_1, b_2) \in A^C$ but "not too far" from A
   - countries fight inflation by decreasing their debt levels so set $\dot{b} < 0$ until they reach set A
3. *Give up fighting inflation*: if $(b_1, b_2) \in A^C$ and "too far" from A
   - countries give up fighting inflation: $\dot{b} = 0$



Next: decentralized regime

Decentralized Regime

Local Fiscal Authority

- Each country's local fiscal authority chooses (c_i, ℓ_i) to maximize utility of their country
- Strategic interaction: inflation depends on what all other countries choose
- Given $\pi(\boldsymbol{b}), i(\boldsymbol{b})$, and $\{c_j(\boldsymbol{b}), \ell_j(\boldsymbol{b})\}_{j \neq i}$, the problem of the local fiscal authority is

$$V_i^D(\boldsymbol{b}_0) = \max_{\dot{b}_{it}, c_{it}, \ell_{it} \in [0, \bar{\ell}]} \int_0^\infty e^{-\rho t} \left[u(c_{it}) - \ell_{it} - \psi \pi(\boldsymbol{b}_t) \right] dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_{it} + \rho b_{it} - \ell_{it}$$

$$\dot{b}_{jt} = c_j(\boldsymbol{b}_t) + \rho b_{jt} - \ell_j(\boldsymbol{b}_t) \quad \forall j \neq i$$

Local Fiscal Authority

- Each country's local fiscal authority chooses (c_i, ℓ_i) to maximize utility of their country
- Strategic interaction: inflation depends on what all other countries choose
- Given $\pi(\boldsymbol{b}), i(\boldsymbol{b})$, and $\{c_j(\boldsymbol{b}), \ell_j(\boldsymbol{b})\}_{j \neq i}$, the problem of the local fiscal authority is

$$V_i^D(\boldsymbol{b}_0) = \max_{\dot{b}_{it}, c_{it}, \ell_{it} \in [0, \bar{\ell}]} \int_0^\infty e^{-\rho t} \left[u(c_{it}) - \ell_{it} - \psi \pi(\boldsymbol{b}_t) \right] dt$$

$$\text{s.t.} \quad \dot{b}_{it} = c_{it} + \rho b_{it} - \ell_{it}$$

$$\dot{b}_{jt} = c_j(\boldsymbol{b}_t) + \rho b_{jt} - \ell_j(\boldsymbol{b}_t) \quad \forall j \neq i$$

- Why is characterizing solution difficult? Strategic interaction btw countries and monetary authority
  - affects the dynamics of *inflation* and *debt* in a complex manner
  - because when player i moves in t, affects other players in $t+1$, which in turns affects i in $t+1$ and so on
  - hence sets off *infinite sequence of deviations*
  - so even symm. equilibrium involves solving highly nonlinear system of country-level best responses off path

Local Fiscal Authority: What is the Externality?

- The equilibrium inflation rule is the same as in the centralized regime

$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \psi \geq \frac{1}{I} \sum_i u'(\hat{c}_i(b_i))b_i \\ \bar{\pi} & \text{if} \quad \psi < \frac{1}{I} \sum_i u'(\hat{c}_i(b_i))b_i \end{cases}$$

- What is the externality?

Local Fiscal Authority: What is the Externality?

- The equilibrium inflation rule is the same as in the centralized regime

$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \psi \geq \frac{1}{I} \sum_i u'(\hat{c}_i(b_i))b_i \\ \bar{\pi} & \text{if} \quad \psi < \frac{1}{I} \sum_i u'(\hat{c}_i(b_i))b_i \end{cases}$$

- What is the externality?
  - not direct: actions of country i do not affect either utility or production of any other country
  - but indirect: actions of country i do affect response of monetary authority

Local Fiscal Authority: What is the Externality?

- The equilibrium inflation rule is the same as in the centralized regime

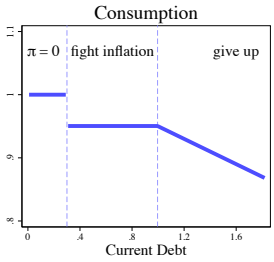
$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \psi \geq \frac{1}{I}\sum_i u'(\hat{c}_i(b_i))b_i \\ \bar{\pi} & \text{if} \quad \psi < \frac{1}{I}\sum_i u'(\hat{c}_i(b_i))b_i \end{cases}$$

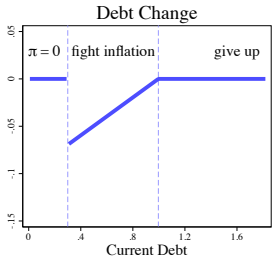
- What is the externality?
  - not direct: actions of country i do not affect either utility or production of any other country
  - but indirect: actions of country i do affect response of monetary authority

- Indirect: fiscal authorities don't internalize effect on others by influencing the monetary authority

- Since the weight that each country receives in the inflation rule is $1/I$
  - as I increases, each country's influence on inflation becomes smaller
  - so each country chooses to *fight less hard* (higher c_{it}), and *give up fighting sooner*
  - externality gets worse, and as $I \uparrow \infty$: never fight in first place (as in Aguiar et al. 2015)

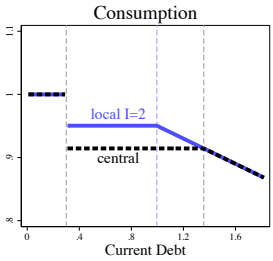
Local Fiscal Authority: Characterization of Equilibrium with $I = 2$

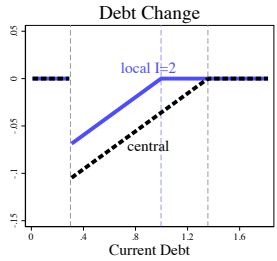




- Same qualitative form as in the centralized regime
- In the fighting region: sacrifice current consumption to reduce debt and achieve $\pi = 0$
- Next: compare the incentives of local and central fiscal authorities

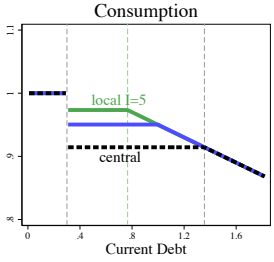
Compare Local and Central Fiscal Authority Equilibria with $I = 2$

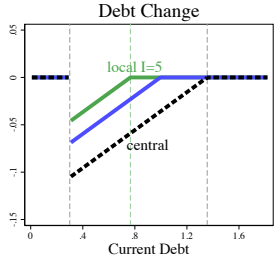




- In both regimes, consumption is *constant* along the debt reduction path, but $\underline{c}^D(I) > \underline{c}^C$
  - debt decreases *slower* under decentralized so takes longer to get zero inflation
  - under decentralized, give up fighting inflation at lower levels of debt
  - overall welfare higher under centralized because it gets to $\pi = 0$ *faster*
- Key fiscal externality: each country only internalize $1/I$ of the inflation cost

Compare Local and Central Fiscal Authority Equilibria with $I = 5$





- As the number of countries in the union I increases
  - don't *fight inflation* as hard: $\underline{c}^D(I)$ increases with I
  - the rate at which debt decreases is slower: takes longer to reach the zero inflation area
  - so decentralized welfare decreases
  - *give up* fighting inflation for lower levels of debt; if $I \uparrow \infty$: give up immediately (Aguiar et al.)
- Summary: absent fiscal federalism considerations, centralization always preferred

How Results Change With Fiscal Federalism Considerations

Central Fiscal Authority Has Information Disadvantage

- Go back to the general problem in which countries have heterogeneous preferences about g
- Preferences in each country i are given by

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

- Information structure
  - $\boldsymbol{\theta_t} \equiv (\theta_{1t},\ldots,\theta_{It})$ is a random variable in probability space $(\Omega,\mathcal{F},\mathcal{P})$ and iid across i

Central Fiscal Authority Has Information Disadvantage

- Go back to the general problem in which countries have heterogeneous preferences about g
- Preferences in each country i are given by

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

- Information structure
  - $\boldsymbol{\theta_t} \equiv (\theta_{1t},\ldots,\theta_{It})$ is a random variable in probability space $(\Omega,\mathcal{F},\mathcal{P})$ and iid across i
  - local fiscal authority observes θ_{it}

Central Fiscal Authority Has Information Disadvantage

- Go back to the general problem in which countries have heterogeneous preferences about g
- Preferences in each country i are given by

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

- Information structure
  - $\boldsymbol{\theta_t} \equiv (\theta_{1t},\ldots,\theta_{It})$ is a random variable in probability space $(\Omega,\mathcal{F},\mathcal{P})$ and iid across i
  - local fiscal authority observes θ_{it}
  - central authority only observes noisy signals $\boldsymbol{s_t}$ about $\boldsymbol{\theta_t}$

Central Fiscal Authority Has Information Disadvantage

- Go back to the general problem in which countries have heterogeneous preferences about g
- Preferences in each country i are given by

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

- Information structure
  - $\boldsymbol{\theta_t} \equiv (\theta_{1t},\ldots,\theta_{It})$ is a random variable in probability space $(\Omega,\mathcal{F},\mathcal{P})$ and iid across i
  - local fiscal authority observes θ_{it}
  - central authority only observes noisy signals $\boldsymbol{s_t}$ about $\boldsymbol{\theta_t}$
- Leading example: $\theta_{it} \in \{\theta_L, \theta_H\}$ with $0 < \theta_L < \theta_H < 1$
  - at a given Poisson rate λ, preference θ_{it} switches from θ_L to θ_H and vice versa
  - central fiscal authority learns value of current θ_{it} with Poisson rate ϕ capturing degree of informativeness

Central Fiscal Authority Has Information Disadvantage

- Go back to the general problem in which countries have heterogeneous preferences about g
- Preferences in each country i are given by

$$\mathbb{E}\int_0^\infty e^{-\rho t}\left[(1-\theta_{it})u\left(c_{it}\right)+\theta_{it}h(g_{it})-\ell_{it}-\psi\pi_t\right]dt$$

- Information structure
  - $\boldsymbol{\theta_t} \equiv (\theta_{1t},\ldots,\theta_{It})$ is a random variable in probability space $(\Omega,\mathcal{F},\mathcal{P})$ and iid across i
  - local fiscal authority observes θ_{it}
  - central authority only observes noisy signals $\boldsymbol{s_t}$ about $\boldsymbol{\theta_t}$
- Leading example: $\theta_{it}\in\{\theta_L,\theta_H\}$ with $0<\theta_L<\theta_H<1$
  - at a given Poisson rate λ, preference θ_{it} switches from θ_L to θ_H and vice versa
  - central fiscal authority learns value of current θ_{it} with Poisson rate ϕ capturing degree of informativeness
- Specialize to $u(x)=h(x)=\log(x)$ so total cons. $c+g$ does not vary with θ, only its composition
  - thus debt dynamics are *identical* to the economy with only fiscal externalities

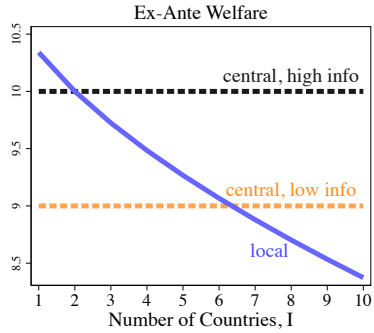
Cutoff Rule Result

- There exists a cutoff in the number of countries $\mathcal{I}(b;\phi)$, potentially infinity, s.t.
  - if $I < \mathcal{I}(b;\phi)$ decentralization is preferred because of the info advantage
  - if $I \geq \mathcal{I}(b;\phi)$ centralization is preferred because the externality becomes worse sketch

Cutoff Rule Result

- There exists a cutoff in the number of countries $\mathcal{I}(b;\phi)$, potentially infinity, s.t.
  - if $I < \mathcal{I}(b;\phi)$ decentralization is preferred because of the info advantage
  - if $I \geq \mathcal{I}(b;\phi)$ centralization is preferred because the externality becomes worse sketch

- As information becomes worse, centralized welfare decreases, so cutoff increases



Cutoff Rule Result for Poisson Case

Proposition. Let $(b_{i0}, \theta_{i0}) = (b, \theta)$ for all i and central authority learns $\boldsymbol{\theta}$ with arrival rate $\phi < \infty$.

a) if $b \leq \psi$ (*no inflation*) or $b \geq \overline{b}(I = 1)$ (*give up* under centralized)

- then a decentralized regime is always preferred

b) if $b \in (\psi, \overline{b})$, then a centralized regime is preferred if and only if $I > \mathcal{I}(b; \phi)$

c) the cutoff $\mathcal{I}(b; \phi)$ decreases in the informativeness of ϕ

- if $\phi' > \phi$, then $\mathcal{I}(b; \phi') \leq \mathcal{I}(b; \phi)$

Information in the General Case

- Decentralized fiscal authority of country i perfectly observes $\theta_{i,t}$
  - information: the filtration $(\mathcal{F}_t^i)$, where $\mathcal{F}_t^i = \sigma(\theta_{i,\tau}, 0 \leq \tau \leq t)$

- Centralized fiscal authority observes noisy signals $\boldsymbol{s_t} \equiv (s_{1,t}, \ldots, s_{i,t})$
  - information: the filtration $(\mathcal{F}_t^C)$, where $\mathcal{F}_t^C = \sigma(\boldsymbol{s_\tau}, 0 \leq \tau \leq t)$

- Information in decentralized regime is more precise than in centralized regime
  - if $\boldsymbol{s_t}$ is a noisy signal of $\boldsymbol{\theta_t}$ that is, $\mathcal{F}_t^C \subset \cap_{i=1}^I \mathcal{F}_t^i$
  - loosely, the partition on states of centralized FA coarser than that of decentralized FA

Cutoff Rule in General Case

Proposition. Let $(b_{i0}, \theta_{i0}) = (b, \theta)$ for all i and the information under the decentralized regime $\cap_i \mathcal{F}^i$ be more precise than the information under the centralized regime $\mathcal{F}^C$.

a) if $b \leq \psi$ (*no inflation*) or $b \geq \overline{b}(I = 1)$ (*give up* under centralized)

- then a decentralized regime is always preferred

b) if $b \in (\psi, \overline{b})$, then a centralized regime is preferred if and only if $I > \mathcal{I}(b; \mathcal{F}^C)$.

c) the cutoff $\mathcal{I}(b; \mathcal{F}^C)$ decreases in the informativeness of $\mathcal{F}^C$

- if $\mathcal{F}^C \subset \tilde{\mathcal{F}}^C$, then $\mathcal{I}(b; \mathcal{F}^C) \leq \mathcal{I}(b; \tilde{\mathcal{F}}^C)$

Conclusion

- Propose new set of principles to govern optimal delegation in monetary unions
  - no longer simply always *centralize*
  - rather: centralization is optimal *if and only if monetary union is sufficiently large*

- Implications for actual design of monetary unions that run counter to standard intuition
  - as EU expands eastwards, it should become *more centralized*
  - rather than less centralized as is often contended

Local Fiscal Authority: How to Solve the Game?

- We are interested in solving the symmetric case: $b_1 = \cdots = b_I = b$
- But the equilibrium requires defining fiscal rules $(c_i(\boldsymbol{b}), l_i(\boldsymbol{b}))$ for every possible $\boldsymbol{b} \in \mathbb{R}^I$
- Construct a subset $B \subset \mathbb{R}^I$, that includes the symmetric case, and restricts $\boldsymbol{b_t} \in B$, for all t
- Analytically characterize the solution in B; in particular, the symmetric case
- Provide sufficient conditions to extend our solution from B to the entire domain
- We cannot prove that these conditions are satisfied, so we numerically check that they are back

Equilbrium Inflation Rule: Proof

- The optimal inflation rule is

$$\pi(\boldsymbol{b}) = \begin{cases} 0 & \text{if} \quad \psi \geq -\sum_i \frac{\partial J(\boldsymbol{b})}{\partial b_i} b_i \\ \bar{\pi} & \text{if} \quad \psi < -\sum_i \frac{\partial J(\boldsymbol{b})}{\partial b_i} b_i \end{cases}$$

- Since $J(\boldsymbol{b}) = \frac{1}{I}\sum_i V_i(\boldsymbol{b})$, where $V_i(\boldsymbol{b})$ is the welfare of country i, we show that if $\pi(\boldsymbol{b}) = 0$

$$-\frac{\partial J(\boldsymbol{b})}{\partial b_i} = -\frac{1}{I}\frac{\partial V_i(\boldsymbol{b})}{\partial b_i} = \frac{1}{I}u'(\tilde{c}_i^*(\boldsymbol{b}))$$

- How do we prove this? If inflation is zero, $\dot{b}_{i,t} = 0$ for every country under both regimes

- First equality: if inflation is zero, $V_i(\boldsymbol{b})$ only depends on $b_i \rightarrow \frac{\partial J(\boldsymbol{b})}{\partial b_i} = \frac{1}{I}\sum_j \frac{\partial V_j(\boldsymbol{b})}{\partial b_i} = \frac{1}{I}\frac{\partial V_i(\boldsymbol{b})}{\partial b_i}$

- Second equality: since $\dot{b}_i = 0 \rightarrow \ell_i = c_i + \rho b_i \leq \bar{\ell}$, hence

$$\rho V_i(\boldsymbol{b}) = \max_{c_i \leq \bar{\ell} - \rho b_i}[u(c_i) - (c_i + \rho b_i)] \rightarrow \frac{\partial V_i(\boldsymbol{b})}{\partial b_i} = -u'(\tilde{c}_i^*(\boldsymbol{b}))$$

back

A Separation Result With Log Utility in Two Parts

- Debt dynamics identical to the economy with only fiscal externalities
  - total consumption, $c + g$, does not vary with θ, only its composition

- Welfare is sum of welfare with only externality and a term that captures benefits of info structure
  - externality term: same as before, $J^C(\boldsymbol{b})$ for centralized and $J^D(\boldsymbol{b}, I)$ for decentralized
  - info structure term: only depends on $\boldsymbol{\theta}_t$ (or its expectation, for the central authority)

A Separation Result With Log Utility

Proposition. Ex-ante welfare in an economy with heterogeneous preferences for g given by $\boldsymbol{\theta_t}$ is

$$\tilde{J}^C(\boldsymbol{b}, \boldsymbol{\theta}) = J^C(\boldsymbol{b}) + f(\boldsymbol{\theta}|\mathcal{F}^C) \quad \text{and} \quad \tilde{J}^D(\boldsymbol{b}, \boldsymbol{\theta}, I) = J^D(\boldsymbol{b}, I) + f(\boldsymbol{\theta}|\cap_i \mathcal{F}^i),$$

with $\hat{\theta}_{i,t} \equiv \mathbb{E}\left[\theta_{i,t}|\mathcal{F}_t\right]$, $\mathcal{F} = (\mathcal{F}_t)$ and

$$f(\boldsymbol{\theta}|\mathcal{F}) \equiv \frac{1}{I}\sum_i \mathbb{E}_{\boldsymbol{\theta}} \int_0^\infty e^{-\rho t}\left[\hat{\theta}_{i,t}\log\hat{\theta}_{i,t} + (1-\hat{\theta}_{i,t})\log(1-\hat{\theta}_{i,t})\right] dt,$$

where $J^C(\boldsymbol{b})$ and $J^D(\boldsymbol{b}, I)$ are the value functions from the economy with only externalities.

A Separation Result With Log Utility: The Symmetric Case

- Consider the symmetric case: $b_{i,0} = b,\ \theta_{i,0} = \theta$ for all i, so, with a slight abuse of notation,

$$\tilde{J}^C(b,\theta) = J^C(b) + f(\theta|\mathcal{F}^C) \quad \text{and} \quad \tilde{J}^D(b,\theta,I) = J^D(b,I) + f(\theta|\cap_i \mathcal{F}^i),$$

  where, since $\theta_{i,t}$ is i.i.d. across i: $f(\theta|\mathcal{F}) = \mathbb{E}_\theta \int_0^\infty e^{-\rho t}\left[\hat{\theta}_t \log \hat{\theta}_t + (1-\hat{\theta}_t)\log(1-\hat{\theta}_t)\right] dt$

- the info. structure part $f(\cdot)$ does not depend on I
  - centralized welfare *does not change* with I whereas decentralized welfare *decreases* with I
- $f(\cdot)$ increases with the informativeness of $\mathcal{F}$: if $\mathcal{F} \subset \tilde{\mathcal{F}}$, then $f(\theta|\mathcal{F}) \geq f(\theta|\tilde{\mathcal{F}})$
  - since decentralized has better info: $f(\theta|\cap_i \mathcal{F}^i) \geq f(\theta|\mathcal{F}^C)$
- If $I = 1$, there is no externality so decentralize wins
- Since only decentralized welfare decreases with I, centralize wins if I is large enough
- Thus, we obtain our cutoff result back